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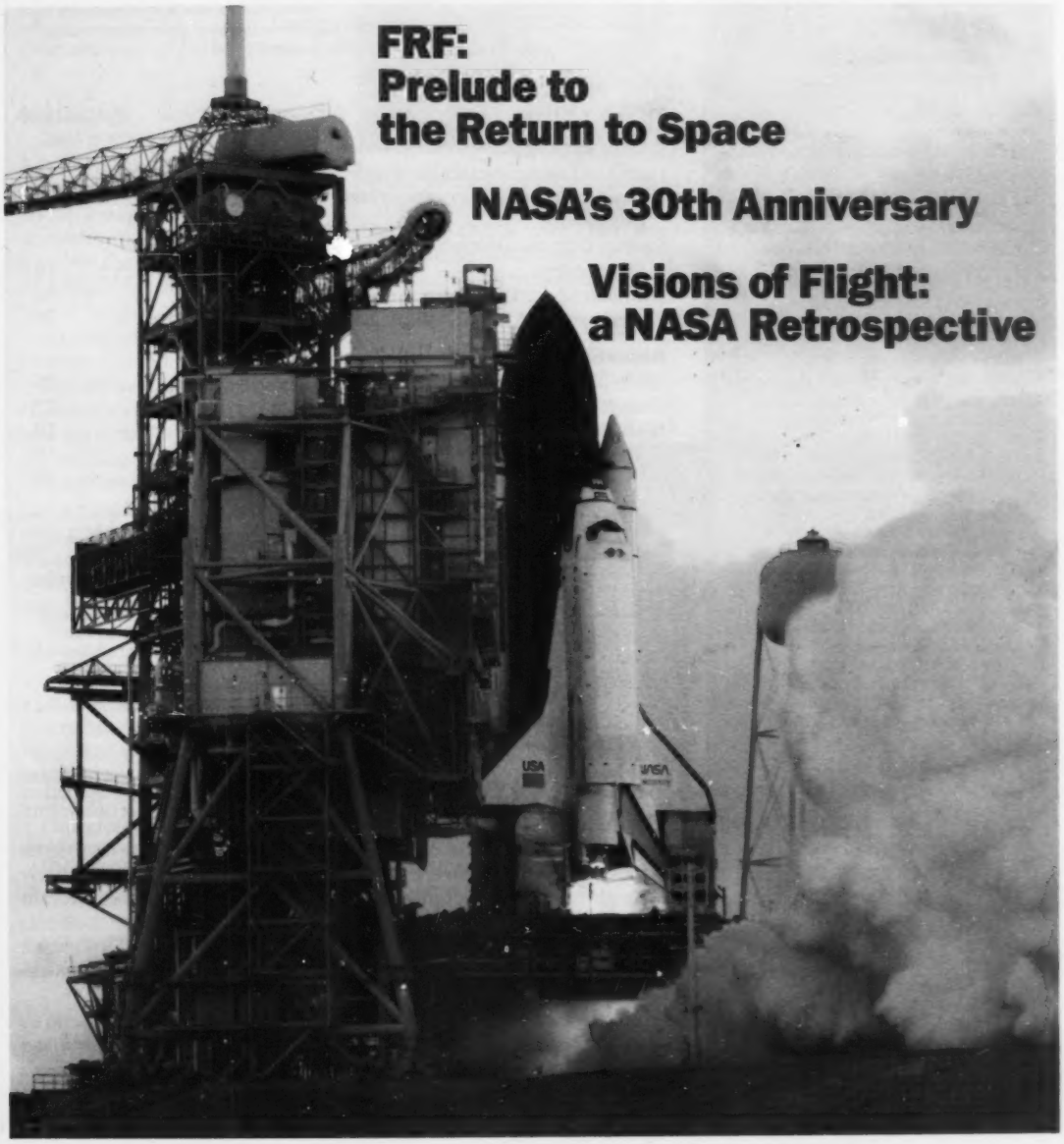

FRF: Prelude to the Return to Space

NASA's 30th Anniversary

Visions of Flight: a NASA Retrospective

THIS ISSUE

This issue of NASA Activities comes at a unique time: during the Agency's return to space after a painstaking reevaluation of the Space Shuttle and at the conclusion of its 30th year. The accomplishments of both are recorded in this issue.

"Inside NASA" takes a look at how NASA sees itself over the years with an interview with Dr. Sylvia Fries, NASA's chief historian, and it is not cobwebs and dust motes. How we look at ourselves can help determine the progress we make in the future.

Man's perception of his Universe is ever-expanding. But, in biblical words, **"we see through a glass darkly."** This issue includes a look at how NASA uses computational methods to see that which is very difficult to see: airflow through a running jet engine.

The nation had a chance to view NASA at the Experimental Aircraft Association's 36th Annual Fly-In convention at **Oshkosh** this summer. The many facets of NASA were presented in a major exhibit. Over three-quarters of a million visitors attended EAA this year, even those without wings.

"O wad some pow'r the giftie gie us to see oursels as others see us." NASA's art program is featured in this month's "NASA Visions," a small taste of a special exhibit touring the U.S., Canada and Europe. Seen through the eyes of the nation's top artists, NASA's part in the American story takes on an even deeper dimension.

New ways for increased mastery of airborne flight flow from NASA's aeronautics Centers. A vortex flap is being studied at Langley Research Center that promises increased maneuverability in high performance aircraft.

"Record high temperatures seared the nation" was the weatherman's litany this summer. The question is whether or not we've brought it upon ourselves "Q&A" looks at two informed opinions on the greenhouse subject.

Next Month:

The flight of STS-26. Discovery debuts our return to space.

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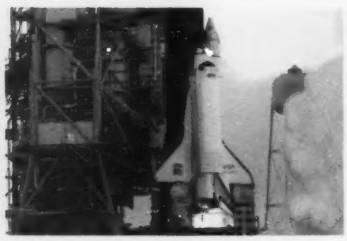

About the Cover

Flight Readiness Firing. Approximately 22 seconds of firing of the Space Shuttle Discovery main engines was a successful prelude to the program's return to space. The firing was conducted to evaluate the performance of various components of the shuttle, external tank and solid rocket boosters, as well as the launch facilities and support equipment used for the launch of STS-26.

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NASA Marks Thirtieth Anniversary

A retrospective of three decades of remarkable accomplishments in air and space

On October 1, 1988, NASA marked three decades of achievements in aeronautics and space. In retrospect, it was a period of remarkable scientific and technological accomplishments that pioneered the space frontier, made quantum leaps in man's understanding of his planet and his universe and saw revolutionary advances in the field of aeronautics.

Beginnings

On April 2, 1958, the Eisenhower Administration submitted a bill establishing a national aeronautics and space agency. After refinements, President Eisenhower signed into law the National Aeronautics and Space Act of 1958. The National Aeronautics and Space Administration came into being on October 1, 1958.

The act established a broad charter for civilian aeronautical and space research. It absorbed the existing National Advisory Committee for Aeronautics and made broad transfers from other government programs. The broadest possible dissemination of information to the public was a unique part of the act.

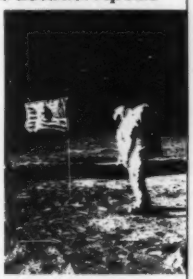
The Soviet Union Launch on October 4, 1957, of Sputnik I, the world's first artificial satellite, had a profound effect on the United States. Sputnik spurred the growing political consensus that national space program was essential.

On January 31, 1958, the first American satellite, Explorer I, went into orbit, leading to the discovery of the Van Allen radiation belt. On March 17, 1958, Vanguard I joined Explorer I in orbit.

Launch vehicle development occupied much attention in NASA's early years, leading to the Scout, Centaur and Saturn launch vehicles.

Mercury was America's pioneering manned space flight program. Alan B. Shepard, Jr. was the first American to fly in space in the Freedom 7 Mercury spacecraft, while John Glen became the first American to orbit Earth. Mercury and the two-man Gemini program verified man's ability to live and function skillfully in space.

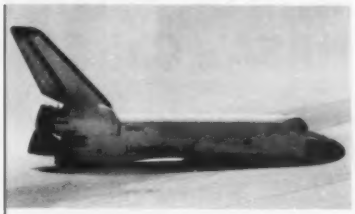
On May 25, 1961, President Kennedy announced a national goal of "landing a man on the moon and returning him safely to Earth" within the decade. Apollo vastly expanded knowledge about the moon and Earth. Six Apollo expeditions explored the moon, the last in December 1972.



Skylab, America's first space station, investigated long-duration space flight, while the Apollo-Soyuz Test Project in 1975 was the world's first international manned space mission. It tested compatible rendezvous and docking systems and conducted scientific investigations.

With the launch of the Space Shuttle Columbia on April 12, 1981, the United States entered a new era in transportation for living and working in space.

The Space Transportation System achieved 24 successful flights including Columbia's maiden voyage. The 25th Shuttle



flight in January 1986 ended in disaster, with the explosion of the orbiter Challenger and the loss of its crew. The Challenger accident led to a period of reevaluation and redesign of the orbiter's systems and improvements in the Shuttle management process.

Aeronautical programs run the gamut from fundamental, disciplinary research to flight testing. The X-15 spaceplane of the 60s was a highlight of NASA's flight research. Aeronautics research also focuses on the aerodynamics of space vehicles.

The National Aerospace Plane program is a NASA/DOD accelerated technology development program leading to a flight research vehicle (X-30) to validate a wide range of aerospace technologies and capabilities, including horizontal takeoff and landing, single-stage operation to orbital speeds and sustained hypersonic cruise within the atmosphere using airbreathing propulsion.

NASA's space science programs have explored virtually our entire

Continued on page 20

INSIDE NASA

A NASA Activities Interview with Dr. Sylvia Fries, NASA's Chief Historian

While there are many amateur historians at NASA, and one might jokingly suggest that anyone who has been with NASA for more than five minutes qualifies, in actuality there are probably no more than 15 professionally trained space program historians in the country. It is the province of NASA's chief historian, Dr. Sylvia Fries, her staff of four, and fellow historians to dispel myth and to dispassionately collect agency history.

Early memories. In the summer of 1969, Sylvia Fries was completing her dissertation for a Ph.D. in the History of Ideas at The Johns Hopkins University, Baltimore. She was teaching a summer session at the school, and, like most struggling graduate students, remembers living simply with student loans and borrowed furniture. That summer she rescued an old black and white Admiral TV from a dumpster and used a coat hanger as antenna to watch the first Moon landing.

Her earliest memories of NASA and the space program, however, predate Neil Armstrong's moonwalk. Dr. Fries remembers "the excitement of putting a man on top of a rocket" when Alan Shepard made his first suborbital flight for Project Mercury. She recalls the wonder of watching events taking place on the other side of the globe while sitting in her living room, thanks to the earliest communications satellites. More recently, she remembers the excitement of the first Shuttle test flight. Yet, Dr. Fries explains that the excitement of each event was, in her opinion transitory. In the profoundly "exciting department," Dr. Fries talks animatedly about being at JPL to witness the Voyager fly-by of Saturn.

Like personal memories, with time many pieces of information and fact slip into obscurity and escape from our cultural memory, while others accrete to form historical accounts of the past. Everything that happened yesterday does not become history tomorrow. Current events undergo a transformation on their way to becoming history. Is there a place in time where current events set on a temporal horizon to re-emerge as history?

Current history. Many historians once believed that history's temporal horizon occured in 1945, and that events occurring after 1945, should be considered current, and therefore, incapable of objective historical study. Before coming to NASA in 1983, Dr. Fries had shared this view. Later, she "realized that for historians to stay away from more recent things was self- defeating. Historians could bring a certain kind of perspective to current issues that if neglected by historians, our understanding of current issues would be in the hands of journalists and political columnists who would make whatever hay out of them they could." Fries explains that "whether historians liked it or not, they had a responsibility to look at current history... for pragmatic reasons."

The problem of historical objectivity. In addition to the problem of determining when a current event becomes history, historians have had to struggle with the problem of objectivity. "There was a myth of objectivity that historians tried to claim for themselves, that historians be objective," says Fries. This myth was broken down by people like Thomas Kuhn in his book, The Structure of Scientific Revolutions, which led historians of science to the realization that "even science is not always objective." Fries says that the appropriate role of the historian is roughly analagous to that of a jurist, who believes that "all of the evidence should be given a fair hearing... with opposing points of view presented."

What does history have to do with a forward looking, technologically advanced agency helping to explore and shape the future?

Not an agency attic. While for some people the very mention of history may trigger a reflexive yawn and conjure up images of dusty old books and doddering professors, this image of NASA's history office is wholly inaccurate as well as undeserved. NASA's chief Historian says that people "make a mistake by thinking we're the agency's attic, that we collect stuff here and it gathers dust."

A living collection. The NASA history collection is not an official records collection; it is a reference file with all materials readily accessible. Dr. Fries explains, "we are not a library. We don't collect books. We collect documents of all kinds. It is a living collection used by NASA managers, the academic community, other Government agencies, Congress, and the media."

In addition to maintaining an active reference collection of

historical documents, the history office sponsors several modest, yet broad ranging programs including an aerospace fellowship administered by the American Historical Association for the historical study of the space program. The history office makes one-to-two awards annually, ranging from $15,000 for a graduate or pre-doctoral student to $25,000 for a recent post-doctorate. In addition to these aerospace history fellowships, the history office awards smaller study contracts (under $10,000) in its "Small Study Program" to fund shorter projects or bibliographic studies. A third program area is the new series of historical publications that is published for NASA through a special arrangement with The Johns Hopkins University Press. Publications produced in this series focus on broad or innovative themes.

"Parochialism doesn't pay, if you're trying to understand NASA," Fries says. "The guidelines for each of these initiatives are intentionally broad in order to capture 'larger processes' including... institutional change, technological innovation, the changing relationship of national politics and federal research and technology programs. NASA's history cannot be understood unless you relate it to these other processes. You can't understand NASA by isolating it from the universe in which it operates."

Are some historical periods or programs more popular than others? Is one era in the agency's past more historically rich than another?

Popular history. Dr. Fries explains that historical documentation "tends to reflect the agency's own priorities and what the public interest has been. Public interest, in the agency's opinion, has tended to be on the manned space flight programs."

"During the 1960s the Apollo program was rolling," Fries says. "Developing and writing the story of Apollo was a natural emphasis. Now, from a programmatic point of view, I am trying to counterbalance the great emphasis on the manned space flight program by looking into other topics that may cross over into manned space flight, but may not necessarily." For example, Dr. Fries explains that while aeronautical research has not been totally neglected, it has not received the same amount of attention given to manned space flight. To compensate, Dr. Fries has placed the topic of aeronautical research high on her list of projects.

Rediscovering history. Dr. Fries explains that while "aeronautics represents a relatively small part of NASA's budget and there is relatively little hype about NASA's aeronautical work, I feel intuitively that in the long run when historians look back and say, 'now what are some of the more useful things that NASA has done,' they will see a tradition of aeronautical research that has contributed as much as the space program." According to Dr. Fries, the unsung hero in this little known story is the bench engineer.

"The hero for me is the bench engineer." Dr. Fries is quick to qualify this remark with an explanation that, "the average person thinks of history as a story of heroes and villains. I don't, and few professional historians do either. They, and I, think of history as a process involving many different people and driven by events that are often unpredictable and uncontrollable. The enthusiasm and creativity of NASA's engineers had much to do with what the agency was able to accomplish in the early years. The ability of the agency to preserve that important intangible asset will be one of the tests by which it will be measured in the long run."

Which of today's current events will find their way into tomorrow's history books?

Organizational culture. One thing that will make it into the history books is a study of NASA's organizational culture currently underway.

Manned flight programs. Fries predicts that "Historians 10 or 15 years from now will see that one of the big issues...will be the manned space flight program. Whether, in fact, having men and women in space, considering the cost for all manned programs, did not create for NASA one of its biggest political problems."

A make or break year. Echoing remarks made by Administrator James C. Fletcher, the year 1988, should make it into the history books as, a "make or break year." Fries says that "From a historian's point of view, I think this is a time for the country and NASA to decide whether it wants a strong, across the board program in which it is really making qualitative advances in a number of areas, or whether it wants to put all of its eggs in one basket — which is a major manned program. It happens to be Space Station now. Before it was Apollo. Then it was Shuttle. After Space Station it will be man to Mars..."

A more balanced view of Shuttle. Fries predicts that current emphasis on the Space Shuttle will diminish when placed in a historical context.

The tight money era. While Dr. Fries believes that labels given to distinct periods in time, such as the Apollo Era or the Golden Age of Exploration are misleading, when pressed to suggest a name for the 1980's she suggests—with tongue-in-cheek—"The tight money era."

AGENCY HIGHLIGHTS

NASA Computational Model to Advance Jet Engine Design, Efficiency

A new computational model achieves a major step toward accurately simulating the complex, fluctuating air flow within aircraft engine turbines and compressors. The model is expected to lead to substantial advances in turbomachinery analysis and eventually to smaller, more efficient, and longer-lived engines.

The new computational model, developed by Man Mohan Rai of NASA's Ames Research Center, Mountain View, Calif., should generate significant savings for the aircraft engine industry when the model is ready for commercial applications.

The NASA model allows analysis of rotor-stator air flows, which form the heart of most turbines and compressors within aircraft engines. The most accurate calculation to date of air flow within turbines, the model provides precise analysis of interior changes in pressure, temperature and velocity. Flow is tracked in the three spatial dimensions over time.

The model performs one of the most complex computer simulations ever performed, involving more than 22 trillion computations. With some adaptation, it may also be used with other rotating machinery, such as prop fan engines and helicopter rotors.

Now valuable as an analytical tool, the model's computer run time must be reduced to be practical for use in the design process. The model now requires 100 hours on an advanced supercomputer for a 3-dimensional single stage calculation.

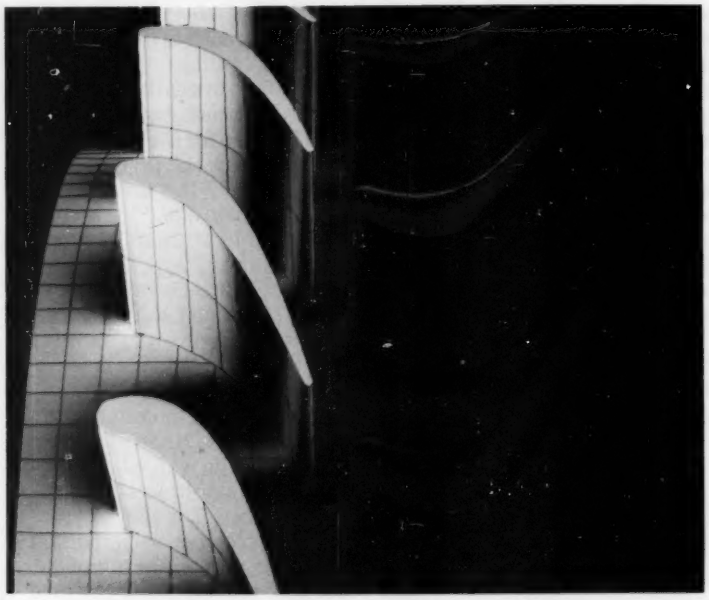
Within a year, researchers expect to reduce the run time to 20 hours, making the model useful in some design areas. The time should be reduced to 1-to-10 hours within 3-to-5 years, depending on the speeds attained by supercomputers and further model development. The model will then have broad applications for analysis of advanced designs.

"This work is significantly more complete than previous simulations," said Terry Holst, chief of the Ames Applied Computational Fluids Branch. "It's extremely difficult to do unsteady three-dimensional Navier-Stokes equations. To do this for complex geometries, as Rai has, is extraordinary. It's a tremendous achievement on the part of Man Rai."

Previous computer models calculating air flow involved major approximations. Some models do not include three-dimensionality or do not calculate unsteady air flow. Others use simplified geometries.

The NASA model's geometry is detailed enough to account for the narrow clearance between the tips of the rotors and the outer casing of the turbine. "We almost give you reality. There's so much information, the problem is where to look," Rai said.

Calculating air flow within turbines and compressors is difficult because the flow continually fluctuates within these components due to the relative motion of some parts respective to other parts.



Computer simulation shows numerically generated pressure contours for flow through a three-dimensional rotor-stator in a typical jet aircraft engine.

Gusts of wind outside an aircraft or other changes in the pressure of air entering the engine also can cause unsteady flow.

This unsteady flow creates fluctuating pressures on engine parts, resulting in thermal and mechanical fatigue that can drastically reduce the lifetime of parts. The NASA model can predict where these stresses will occur, so that engines can be designed to minimize flow-induced stresses or components under stress can be made stronger.

Turbine efficiencies are lowered due to frictional drag produced by the motion of fluids over the turbine blades. In addition, areas of swirling, low-pressure vortice air flow block air going through channels and require more sophisticated flow field analysis. The NASA model predicts the size, strength and location of these vortices. Calculating vortex formation and frictional drag ultimately will help in designing more efficient turbines.

Within an engine, air flows interact around closely- positioned moving parts, creating a complex, unsteady flow field. Generally, the closer the parts are, the more severe the fluctuations become. The NASA model provides understanding of interaction effects, so that parts can be placed closer together. Thus, engines can be made smaller and lighter, saving valuable space and fuel.

Until now, engine concepts and designs have been tested primarily by experimental methods, most often by building prototype engines and subjecting them to a battery of tests. With these methods, studying a large number of configurations is extremely costly and time consuming.

Advanced computer techniques will be far less expensive and much faster. When the NASA model has been optimized, it will be capable of providing a complete analysis of a given design within a few days. ■

Quality, Productivity Conference Scheduled

The Fifth Annual NASA/Contractor Conference on Quality and Productivity will be held October 12-13, 1988. NASA Lewis Research Center will host the conference at the Westlake Holiday Inn in Westlake, Ohio.

Conference topics include quality measurement, teaming, software quality, creating a quality environment, and the NASA Excellence Award for quality and productivity.

The theme, "Quality—A Commitment to the Future," was selected from over 4,000 quality slogans submitted by NASA employees.

Senior executives from NASA and industry are scheduled to participate. Dale D. Myers, NASA deputy administrator, will announce the 1987 recipient(s) of the NASA Excellence Award for quality and productivity, October 12th.

"Quality—
A Commitment
to the Future,"

The eight contractor organizations awaiting this announcement are Bendix Field Engineering Corporation; Boeing Computer Support Services, Inc.; General Electric—Astro Division, Lockheed Engineering and Sciences Company (LESC); Lockheed Space Operations Company; Pan Am World Services, Inc.; Rocketdyne Division, Rockwell International Corporation; and Rockwell Space Transportation Systems Division, Rockwell International Corporation.

Last year's conference attracted over 450 representatives from Government and industry, and some 200 people were turned away because of limited space. ■

NASA, SPACEHAB, Inc., Sign Agreement

In a step to encourage the growth of a strong U.S. commercial space industry, NASA has agreed to provide six shared Space Shuttle flights for a privately developed and financed middeck augmentation module.

NASA and SPACEHAB, Inc., have signed a Space Systems Development Agreement (SSDA) that provides for flights of the company's Shuttle-based module, beginning in 1991.

SPACEHAB, based in Washington, D.C., has initiated final design and construction of a pressurized module that will augment the existing pressurized volume of the Space Shuttle middeck. The Company is marketing access to the module and its support facilities on a commercial basis.

Under the terms of the agreement, SPACEHAB will pay $28.2 million in FY 1988 dollars for standard services for each flight, with payment due 30 days following the landing of each mission. Spacehab does not use the full payload bay. The $28.2 million charge, based on SPACEHAB's share of a mixed payload flight, will be escalated at the time of actual payment to allow for inflation. SPACEHAB will also pay interest on the deferred charges.

In addition, SPACEHAB will be charged in advance of each flight for optional services provided by NASA at the request of SPACEHAB.

The deferred payback provision of the NASA SSDA is one of the mechanisms that has been established to encourage greater investment and involvement by the U.S. private sector in civil space activities. This is the third such agreement signed by NASA.

SPACEHAB was specifically identified in the President's Commercial Space Initiative, announced in February. ■

NASA Aeronautics and Space Programs Featured at Oshkosh

NASA returned to Oshkosh, Wisconsin, recently for the 36th Annual Experimental Aircraft Association (EAA) International Aviation Exhibition with a new exhibit entitled "The Leading Edge in Aeronautics and Space Technology." Other highlights of NASA's participation included a special convention appearance by astronaut Marsha S. Ivins and an expanded NASA craftsmanship exhibit.

The three NASA aeronautics field centers supporting the overall NASA exhibit this year were Lewis Research Center, Cleveland; Langley Research Center, Hampton, VA; and Ames Research Center, Mountain View, Calif., including Dryden Flight Research Facility, Edwards, Calif. The Marshall Space Flight Center, Huntsville, Ala., and the Johnson Space Center, Houston, also provided exhibit materials.

The Goddard Space Flight Center, Greenbelt, Md., provided its SARSAT van, a mobile exhibit telling the story of the Search and Rescue Satellite system. Also on display was the popular AEROVAN travelling exhibit.

More than two dozen NASA speakers conducted technical forums during the convention, ranging from "A Look at Advanced Cockpit Displays" to "The Changing Atmosphere" to "Space Station and its Electrical Power System."

Visitors viewed such exhibits as Improving Materials, Ever Increasing Power, Advancing Aerodynamics and Controls, Vertical and Short Takeoff and Landing Aircraft, Hypersonic Flight, Safety in Flight, and Space Exploration and Utilization.

Also on exhibit was a 1/15th scale Shuttle model in launch configuration supported by photographs depicting the Shuttle recovery effort and STS-26 launch preparations. A Space Station model highlighted the exhibit updating the station's status, while other exhibits illustrated news space technology programs, space science programs and atmospheric science programs such as the mission over the South Pole to study the ozone hole. ■

NASA craftsmanship and research was also on display at the EAA's 36th annual fly-in convention in Oshkosh, Wisconsin. Over 825,000 attended the meet.

Ad Hoc Committee Notes Positive Safety Attitude

An ad hoc committee, assembled to review safety risk management in the National Space Transportation System program, has completed its report, finding that there has been "a positive change in attitude" by NASA and its contractors towards safety.

"Roles and responsibilities have been clarified, safety risk assessments have improved measureably, and the commitment to safety over schedule is freely articulated," the report states. ■

Editor's Note: The following is a complete listing of fellowship participants in lieu of issue No. 7&8's incomplete list.

NASA PARTICIPANTS IN EXTERNAL FELLOWSHIP PROGRAMS 1987-88 ACADEMIC YEAR

HARVARD ADVANCED MANAGEMENT PROGRAM
Roy Estess, NSTL

HARVARD PROGRAM FOR MANAGEMENT DEVELOPMENT
Frank R. Bailey, ARC
Robert E. Easley, JSC

HARVARD SENIOR EXECUTIVE FELLOWS PROGRAM
Wayne L. Draper, JSC
John P. Smith, HQ/R
Mary D. Kerwin, HQ/C

HARVARD SENIOR MANAGERS IN GOVERNMENT
Nathaniel B. Cohen, HQ/L

CARNEGIE-MELLON SENIOR EXECUTIVE SEMINAR
Clarence P. Young, Jr., LaRC
John M. Abbott, LeRC

MIT-SLOAN
John J. McCarthy, HQ/R

STANFORD-SLOAN
William G. Warmbrodt, ARC

MIT-CENTER FOR ADVANCED ENGINEERING STUDY
John R. Facey, HQ/R

SIMMONS MIDDLE MANAGEMENT PROGRAM
Linda J. Quinby, ARC/DFRF
Deidre A. Lee, JSC
Victoria A. Regenie, ARC/DFRF
Alotta E. Taylor, HQ/M

SYRACUSE MID-CAREER EXECUTIVE DEVELOPMENT PROGRAM
Kenneth L. Jacobs, LaRC

HUGH L. DRYDEN MEMORIAL FELLOWSHIP
Colleen N. Hartman, HQ/E

FEDERAL EXECUTIVE INSTITUTE-SEVEN WEEK PROGRAM
Robert D. Kreider, HQ/R
Lewis E. Andrews, HQ/N
John S. Theon, HQ/E
Edmund L. Sanchez, HQ/R
Robert Rosen, HQ/R
David G. Stephens, LaRC
Tom W. Perry, HQ/E
John C. Lemke, GSFC
Chester A. Vaughan, JSC
John Zuk, ARC
Ralph Muraca, LaRC
Jeffrey E. Sutton, HQ/N

INDUSTRIAL COLLEGE OF THE ARMED FORCES
Robin W. Erskine, HQ/M

PENNSYLVANIA STATE MANAGEMENT PROGRAM FOR WOMEN
Linda T. Hannett, KSC
Catherine Bigelow, LaRC

ASRM Production and Testing Sites Announced

NASA has selected the government sites for the production and testing facilities for the agency's planned Space Shuttle Advanced Solid Rocket Motor (ASRM). The Tennessee Valley Authority property, known as Yellow Creek, in northeastern Mississippi, has been selected for the location of the facility for production of the ASRM, while NASA's Stennis Space Center near Bay St. Louis, Miss., has been selected for testing of the motor.

These sites are identified as the government sites in a Request for Proposals (RFP) issued August 22nd for the design, development, test and evaluation of the ASRM. The companies responding to the RFP must use the selected location as the basis for their proposals to build a government-owned, contractor-operated facility, as well as a required proposal of a privately financed option for the required facility.

In addition to the government sites, NASA's ASRM acquisition plan encouraged interested companies to submit an optional proposal for a privately-owned solid rocket motor facility at a site of the offeror's choice.

Maximum utilization also will be made of available manufacturing and computer capability at the Michoud Assembly Facility and the Slidell Computer Complex, both located in southeast Louisiana, to minimize total program costs. It is estimated that job opportunities for about 1,400 people in the northeast Mississippi area and employment of an additional 600 people in the area east of New Orleans could result. ■

Life Sciences Program Detailed

NASA Administrator Dr. James C. Fletcher has accepted the NASA Advisory Council's report detailing strategic plans for the Life Sciences Program, a critical component of manned space missions. This report completes a formal blue ribbon strategy for NASA's science disciplines.

Nobel Laureate Frederick C. Robbins, M.D. chaired the study committee producing a report entitled, "Exploring the Living Universe: Strategic Plan for NASA Life Science."

The National Space Policy renewed U.S. commitment to the exploration and use of space. NASA's Space Life Sciences Program focuses on the health and safety of human space crews. Other interrelated missions of the Life Sciences Program include protecting the Earth's fragile biosphere and exploring the universe for signs of life.

Earth applications from life science research and technology are extensive, ranging from the development of remote health care facilities and the detection of disease from space to the enhancement of supercomputers.

In response to Dr. Fletcher's call for a vigorous and ambitious program in the space life sciences, the Life Sciences Strategic Planning Study Committee produced a comprehensive set of recommendations and has developed scientific and technical strategies to achieve those recommendations.

The resulting report offers recommendations in the following categories: human space flight, gravitational biology, planetary biosciences, flight programs and program administration. ■

NASA VISIONS

NASA Art Retrospective Begins International Tour

"Visions of Flight: Retrospective from the NASA Art Collection" is currently on tour sharing artists' view of significant NASA events. Artists such as Bob McCall, Norman Rockwell, Robert Rauchenberg and James Wyeth, have rendered their impressions of NASA's aeronautics and space program, providing a human perspective that records the facts, as well as the feelings of our civilization.

The collection, selected from NASA's comprehensive archive, consists of 71 paintings that reflect not only the evolution of America's aeronautics and space program, but also the enthusiasm and awe generated by these events.

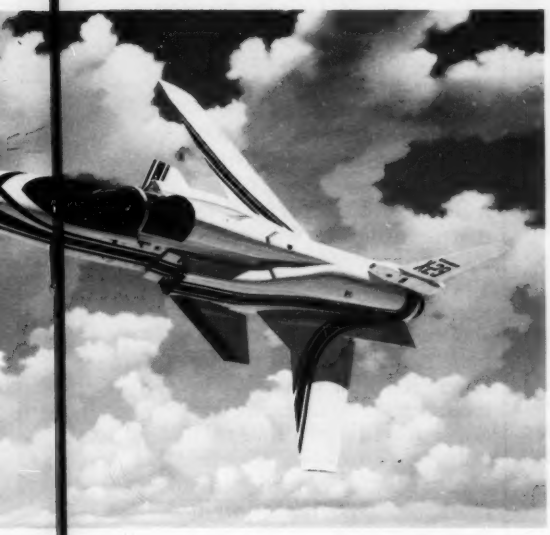
Throughout the past 25 years, NASA has tried to provide artists with every possible experience and view of our advance into space. These special views, combined with the artists' individual interpretations, provide an intimate look at the unbounded space program.

Through the NASA Art Program curated by Robert Schulman, 47 artists working in a variety of styles and media, have contributed paintings to create this collection. The exhibition will travel for approximately three years throughout the U.S., Canada and Europe and is managed by the Smithsonian Institution Traveling Exhibition Service. It is currently on exhibit at the Mesa Southwest Museum, Mesa, Arizona. ■

"X-29" Acrylic by Stan H. Stokes

"Mission 51-D Landing Ope
by George Guzzi

"Bringing in the 'Big Boy'" Acrylic by Pamela Lee



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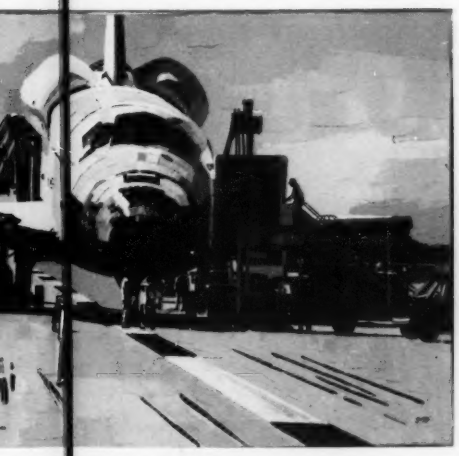
"A Handfull of Emeralds" Oil by David E. Stone



nding Operations at KSC" Acrylic

"Emergence" Acrylic by Dan Namingha

CENTER HIGHLIGHTS

Vortex Flap Promises Increased Maneuverability

By Marnie Skora, LaRC

Flight research that promises to increase the maneuverability of swept wing fighter aircraft by as much as 20 percent is being conducted at NASA's Langely Research Center, Hampton, VA. Flight testing of the vortex flap research experiment began this summer.

First flight initial results delighted team members who reported "no surprises"— a good sign indicating verification of research expectations. Phil Brown, NASA research pilot, was in the cockpit for the first flight. "Although pitch stability was reduced by adding the vortex flap to the F-106B, the airplane has, so far, proved to be only slightly more demanding to fly than the basic airplane and considerably easier to control than the simulator," notes Brown.

Flight testing of the vortex flap follows five years of study encompassing nearly 3,000 hours of wind tunnel testing and hundreds of computer design hours as well as a series of high-speed taxi tests conducted in late July.

Ron Smith, flight project engineer, estimates that approximately 220 people on Center were involved in one way or another. Support for the vortex flap experiment spanned three Directorates. "It's been a Center project from beginning to end, involving lots of truly committed people and making maximum use of existing resources," says Smith.

The vortex flap is an addition to the front of the wing designed to improve the performance capabilities of swept wing aircraft. The concept, identified in the late 70s, promises to address the dilemma faced by designers of fighter aircraft: speed vs maneuverability. Highly swept wings assure speed; but un-swept wings are preferrable for the high lift needed for combat maneuvers and short takeoffs and landings. Even more radical than just extending the forward edge of the wing, the vortex flap is a sharp extension of the leading edge. This sharp extension, deflected downward, purposely detaches the airflow over the wing and forms a tornado-like vortex on the flap, thereby creating a suction force that reduces drag.

The NASA F-106B was identified as the focus aircraft for this flight research experiment. Chosen from three candidate vehicles, the F-106B offered the right wing sweep and the relative ease of structural modifications to accommodate the vortex flap.

Principal investigator Jim Hallissy teamed with Neal Frink to do a preliminary assessment of the realistic constraints of the aircraft that had to be dealt with in designing the vortex flap. Taking a 30-year old airplane and refitting it to evaluate the concept was their challenge. Hallissy cites one example: "We needed to find out just how much of the wing could be modified. For instance, we were not permitted to penetrate the fuel cells. Since most of the wing is used to store fuel, structural modifications could be made only in the wing leading edge and tip areas."

As a result of that assessment, several design points were identified around which initial shapes for the vortex flap were developed. From the geometry developed here, airplane model parts were

The wing on this NASA F-106B has been modified with a leading edge vortex flap, visible here as a dark band on the outside of each wing. The flap forms a tornado-like swirl of air called a vortex that reduces drag and increases lift.

built and tested in the 7 ft.-by-10 ft. wind tunnel and later in the transonic tunnels at Langley and Ames.

The flaps were fabricated on Center and installed on the aircraft by Langley technicians. Instrumentation was designed and installed by Langley instrumentation specialists. Three-hundred-nineteen orifices for wing pressure measurements have been installed and 65 strain gages for real-time load path monitoring have been activated.

The strain gages and dynamic sensors are monitored on the ground via telemetered data link. Computers instantly review the output against pre-determined limits. If a limit is approached, a warning is radioed to the test pilot to unload the aircraft by limiting the test maneuver. There were no alarms during the first flight.

Roy Harris, director for aeronautics, says "The vortex flap is an excellent example of the kind of Langley research that can be carried all the way from idea, to calculations, to sub-scale tests, to flight validation, and provide 'real world' feedback to the researchers." chers."

Other Implications of the Vortex Flap

Ron Smith looks ahead to further advantages of the vortex flap concept. "On any similar delta wing configuration, you could probably design the vortex flap to improve takeoff and landing characteristics. The implication is that on a supersonic transport, if you could improve the lift to drag ratio by 20 percent and take off with better aerodynamics—more lift, then you wouldn't have to light the afterburner and the noise would be significantly lower. That's another potential we see." ■

Scientific Team Announces Discovery of New Superconducting Composite

A team of NASA scientists from the Marshall Space Flight Center in Huntsville, Ala., the Lockheed Company, and the University of Alabama at Huntsville, have announced a new discovery in high-temperature superconductors.

According to a paper published in *Applied Physics Letters*, the scientists have demonstrated that samples of yttrium-barium-copper oxide when mixed with silver oxide, heat treated, and exposed to -320 degrees Fahrenheit, can be suspended below a rare earth magnet by the magnetic field trapped in the sample. All other reported high-temperature superconducting compounds can float above a magnet when cooled, but weigh too much compared to their attractive forces to be suspended below the magnet.

Because a superconducting material excludes a magnetic field, by floating a superconductor beneath a magnet, the two materials are firmly attracted to each other, but never touch. Using this technique, said Dr. Palmer N. Peters of Marshall's Cryogenics Physics Office and a member of the scientific team, "In space, with the elimination of the weight associated with gravity, it should be possible to develop low-vibration, low-friction couplings and bearings."

"The importance of the discovery is that this new material not only has stronger suspension forces but exhibits other unusual magnetic properties: it has demonstrated a lower electrical resistance at normal temperatures, is easier to solder, and is less brittle than other high temperature superconducting materials." What this means, said Peters, is that the new material should be easier to fabricate.

"The higher temperature superconductors can operate on liquid nitrogen, which is one-tenth as expensive as the liquid helium needed for lower temperature superconductors," said Peters. "Maybe someday we'll be using room temperature superconductors, but at this point we still have a long way to go."

The implications of high temperature superconductors for space technology are numerous, according to Peters.

"First, below a certain transition temperature, superconductors lose all electrical resistance. In space we might be able to store solar-generated energy in superconducting magnetic coils instead of batteries," said Peters. "It may be years, however, before suitable coils can be fabricated from high temperature superconductors."

DISCOVERY OF SUPERCONDUCTING COMPOSITE — A sample of a new superconducting material, yttrium-barium-copper oxide mixed with silver oxide, is suspended below a hand-held magnet. The suspended material, cooled in a styrofoam saucer of liquid nitrogen, floats below the magnet due to the magnetic field trapped in the sample.

Special Communications System Prepared for Neptune Encounter

Scientists and engineers from NASA's Jet Propulsion Laboratory (JPL), Pasadena, Calif., and the National Radio Astronomy Observatory (NRAO), Socorro, N.M., are working together in the high plains of central New Mexico to improve the ability to receive spacecraft signals from the vicinity of planet Neptune. The researchers are currently testing a new deep-space communications system with NASA's Voyager 2 spacecraft, which will fly past the eighth planet next year.

When Voyager 2 reaches Neptune in August 1989 to take close-up pictures and thousands of other measurements, the spacecraft will be nearly three billion miles from home. Its signal received on Earth will be extremely faint.

Adding the 27 radio telescopes of the NRAO's Very Large Array (VLA) to JPL's Deep Space Network (DSN), which communicates with interplanetary spacecraft, will more than double the ability to capture Voyager's signal. The signal will be received eight hours per day for 40 days of the encounter — the period that Voyager and Neptune will be above the horizon at the New Mexico desert site.

Under an agreement between NASA and the National Science Foundation, which sponsors NRAO, engineers are installing new receivers and microwave horns, tuned to Voyager's X-Band radio frequency, on all the 82-foot dish antennas at the VLA. Special signal-processing and communication equipment has been added so that the VLA will be linked by satellite to the DSN's Deep Space Communications Complex at Goldstone, Calif.

The new X-Band receiver systems were designed and built cooperatively by JPL, VLA, and NRAO's Central Development Laboratory at Charlottesville, Va. Like those of the DSN, the advanced receiver circuits are kept chilled with liquid helium to suppress internal electronic noise. NASA has also provided an independent power generator for the array, which has suffered power failures from summer lightning storms.

The Voyager spacecraft, now 2.4 billion miles from Earth, will transmit in its planetary encounter mode, at data rates up to 21,600 bits per second (the rate used for Voyager's encounter of Uranus in 1986). Linked electronically, the two systems — 23 VLA antennas that now have their X-Band receivers, and the 112-foot and 230-foot dishes at Goldstone — will function as a single receiving system.

The VLA, located about 100 miles southwest of Albuquerque, has, since 1980, enabled radio astronomers to study distant stars, nebulae and galaxies by collecting and analyzing radio emissions from these objects.

The 27 mobile dishes are arrayed along a Y-shaped railroad track and can be rearranged for different observations. William D. Brundage, VLA project engineer, is responsible for Voyager preparations at Socorro.

Voyager 2 was launched in August 1977, and has subsequently explored the planetary system of Jupiter, Saturn, and Uranus. ■

Johnson Space Center Receives PCMI Award

Johnson Space Center was one of the 15 recipients from all of the federal government to receive the President's Council on Management Improvement (PCMI) Individual and Group Award for Quality and Productivity Improvement.

From left: Joseph R. Wright, Deputy Director, Office of Management and Budget, Ms. Wanda Thrower, Johnson Space Center and Dr. C. Howard Robins Jr., Deputy Associate Administrator, Office of Management, NASA Headquarters.

The award was presented at the first government-wide conference on quality and productivity attended by over 1,200 federal executives and managers in Vienna.

Joseph R. Wright, Jr., deputy director of the Office of Management and Budget and chairman of the PCMI presented the award to Deputy Associate Administrator, Dr. C. Howard Robins, Jr., from the Office of Management and Ms. Wanda Thrower from the Johnson Space Center.

The Center was cited for its TEAM EXCELLLENCE effort—a Centerwide activity directed at developing and implementing a strategic plan to position the Center for meeting the challenges of the Year 2000 and beyond. ■

Experimental Aircraft Makes 200th Flight

The experimental forward swept-wing X-29 aircraft has flown its 200th research mission at NASA's Ames-Dryden Flight Research Facility. The high flight rate, unusual for an experimental aircraft, was made possible by a series of innovative procedures developed by NASA researchers.

The 200th flight marked the most flights ever flown on a single series high performance aircraft, according to NASA X-29 deputy program manager David Lux.

NASA research pilot Rogers Smith flew the 200th mission, gaining that honor by normal pilot rotation. A simulated aerial refueling was included in the mission for handling qualities evaluation.

The development of flight test techniques that make possible multiple research flights and increased productivity have been important aspects of the program.

Gary Trippensee, NASA X-29 program manager says, "we would have never gotten where we are without the expertise, dedication, and motivation of a super X-29 team—NASA, Air Force, and contractor."

During previous research programs, the procedure has been to prepare for one flight, fly, reduce the data before another flight, then begin the whole process again. For the X-29, researchers and pilots prepare for three to four flights, fly those flights in one day, then reduce the data.

This means that the flight planning process is done once, rather than three times. The flight control room, with its many displays and data recording devices, is prepared for the X-29 configuration once for several flights on one day, rather than several days. This in turn gives other research programs more time in the control room.

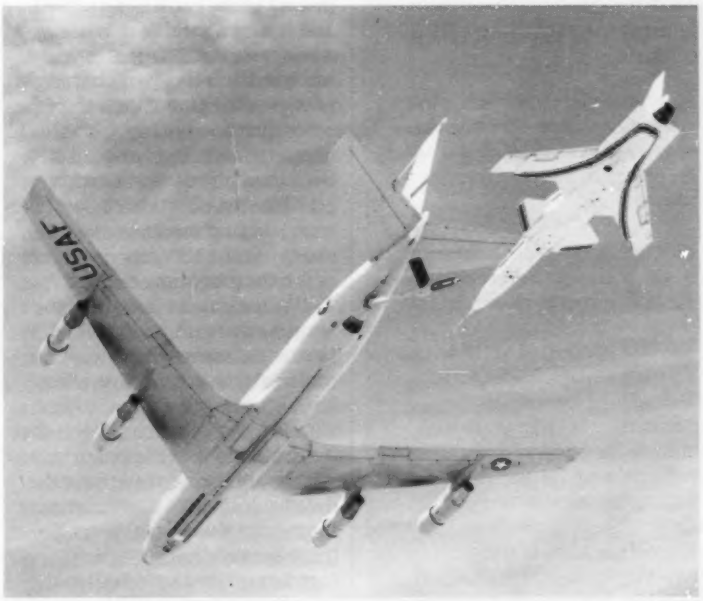
The airplane's crew, led by crew chief Joe Misplay, prepares the aircraft for flight and stages from near the end of the runway to be able to check the aircraft and refuel it quickly between flights. Under the old system, the crew would have prepared the airplane, the X-29 would have flown once, it would then have been brought back from the test range to the Ames Dryden facility, and would need to go through the whole process again for another flight. Three flights could have taken at least six days of preparatory and flight time, rather than the two days it takes with the new system.

Researchers also have more time to work on engineering data, since they have fewer planning meetings to attend.

"The 200th flight is more than just a number," says Lux. "It is representative of the way the X-29 program has changed Ames-Dryden. At first, the engineering team waffled at multiple flights. It forced us to look at ways to increase productivity and to look at the overall system. The X-29 has changed Dryden because people have pushed changes.

To date, results from flight tests have proven that the forward-swept-wing concept is feasible. Improved performance over aft-swept wings has been noted in the subsonic and transonic flight regions. Researchers have developed analysis techniques to verify and prove prediction of wing divergence and possible structural problems.

The airplane has shown improved ride qualities and the ability to encounter atmospheric turbulence without deviations to the flightpath common to other aircraft. ■



The X-29 approaches an Air Force Flight Test Center KC-135 tanker aircraft in a simulated aerial refueling. The X-29 is not equipped for aerial refueling but researchers wanted information for handling qualities evaluation.

Q&A

The following questions and answers are excerpted from interviews conducted for NASA's radio program, "The Space Story."

The Greenhouse Effect

The Earth's atmosphere is like the panes of glass in a greenhouse. Both transmit light, but they also block heat radiation from escaping. Therefore, the surface or the earth and the inside of a greenhouse become warmer. Scientists hold differing opinions concerning the impact of the greenhouse effect.

Q This Summer's weather forecasts were for "continued hot and dry" marking 1988, as the warmest year on record. Is this the greenhouse effect?

A According to NASA scientist James Hansen, head of the Goddard Institute for Space Studies, "We analyzed the measurements of temperature at meteorological stations around the world, and found that the temperatures in the 1980s are the warmest in the history of recorded temperatures...but it's also interesting and important, I think, that the rate of warming between the 1960s and the 1980s is the warmest during the period of instrumental records. So, it is a strong indication that in fact, the greenhouse effect is becoming significant and it's likely that the effects will continue in the coming decades."

"That's happening here on earth because the amount of carbon dioxide, chlorofluorocarbons, methane and other trace gases is increasing due to emissions of these gases, and these gases do transmit sunlight and absorb heat radiation. We have added carbon dioxide to the atmosphere, principally by the burning of fossil fuels, but also deforestation, the burning of wood has added carbon dioxide to the atmosphere."

"If the economic growth rates or if the energy use continues to increase at the rates it occurred in the twentieth century, then we could certainly have very large greenhouse impacts in the twenty first century."

Scientists differ on the effects of the greenhouse phenomenon. Some questions hinge on methods of data gathering in the past and effects of other phenomena.

Q Do we know enough about the greenhouse effect to make decisions?

A According to Dr. Ichtiaque Rasool, NASA Chief Scientist for Global Change, "Year-to-year changes in the climate could be because of many reasons, and the question which we are debating now, because some of the scientists have proposed that this heating of the greenhouse effect is because of the carbon dioxide, has already become perceptible in these heat waves in the United States (may be because of that,) and that is what we'd like to investigate."

"There is a big debate going on in one part of the community especially on how good are the data which we are using to build the history of the earth before 1940, and is it comparable to what we are measuring today...can you really make a 100-year chart right now over the globe? And then the other question is, if the global temperature does change, is it because of the carbon dioxide, or are these the effects because of the sun changing, because of oceans changing at a 100-year time scale or is it the greenhouse effect?"

"We look at the pattern of the temperature around the globe. We look at the sea ice that should be melting if the greenhouse effect has become significant...we should look at the sea level change, we should look at the poles, versus the equator because we have the data from satellites, and compare them from that last 20 years. So these are the projects which together when carried out in the next five years that will begin to pin down whether the greenhouse is the cause or the culprit of the heat wave in the United States." ■

CONGRESSIONAL CORNER

FY 1989 Funding for NASA Pegged at $10.701 Billion

Congressional Corner is written and edited by the Congressional Relations Office.

On August 20, 1988, the President signed into law H.R. 4800, the "Department of Housing and Urban Development—Independent Agencies Appropriations Act for FY 1989," with these words:

The Act contains necessary funding for the Space Station "Freedom." The Space Station will advance the frontiers of scientific knowledge and strengthen cooperation in space among the United States and its allies. The Act also provides important funding needed to restore the Nation's space shuttle capability, which is essential to national security and the effective use of space to meet our economic needs.

Before H.R. 4800 landed on the President's desk, it faced months of hazardous journey through the Congressional legislative labyrinth with funding decisions all the more sensitive due to election year politics. Efforts to reduce NASA funding in order to increase the dollar amounts for sewage treatment, housing programs, and veteran benefits were successfully resisted. The Congress was faced with the stark alternative between NASA, representing the requirements of high technology, and other programs — and the choice was made for space and the future.

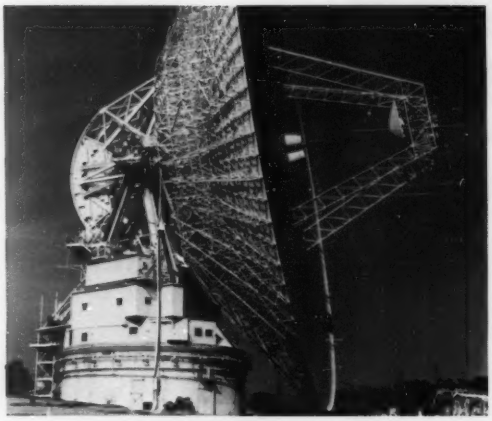
Public Law 100-404 provides a total for NASA of $10.701 billion with language providing for a possible additional $100 million through transfer from the DOD Appropriations Act for unanticipated shuttle requirements. The Space Station is funded at $900 million, with provision for Presidential review by February 1, 1989, with availability of $515 million deferred until May 15, 1989.

The following is a summary of the funding actions as they pertain to NASA: (Totals may not add due to rounding.)

NASA Budget

	REQUEST	P.L. 100-404 (in millions)
Research & Development	**$4446.7**	**$4191.7**
Space Station	967.4	900.0
Space Transportation Cap. Dev.	631.1	606.1
Physics and Astronomy	791.6	735.6
Life Sciences	101.7	76.7
Planetary Exploration	404.0	394.0
Space Applications	562.3	615.7
Commercial Programs	57.9	52.9
Aeronautical R & T	414.2	404.2
Space R & T	390.9	295.9
Transatmospheric R & T	84.4	69.4
Safety, Reliability & Quality Assurance	22.4	22.4
Tracking & Data Adv. Systems	18.8	18.8
Space Flt Control & Data Com.	**$4841.2**	**$4364.2**
Shuttle Production & Cap. Dev.	1400.5	
Shuttle Operations	2405.4	3418.9
Space & Ground Network Operations	1035.3	945.3
Construction of Facilities	**$285.1**	**$290.1**
Research & Program Mgt.	**$1915.0**	**$1855.0**
TOTAL	**$11488.0**	**$10701.0**
Recession of Industrial Space Facility		**— 25.0**
		$10670.0

NASA Deep Space Network to Support Soviet Phobos Mission



NASA's Deep Space Network, Canberra, Australia tracking station.

When the USSR's Phobos spacecraft lifted off for Mars they headed not only for a landing on the tiny Martin moon Phobos but also for a radio rendevous with NASA's Deep Space Network (DSN).

Phobos 1 and Phobos 2, launched a week later, each carry 100-pound landers designed to analyze the 17-mile-long, potato-shaped moon, and the DSN's role in the mission is to provide essential tracking data to permit their landing on Phobos. The DSN then will shift to enabling a key scientific goal of the mission, to track Phobos very precisely. The DSN's 230-foot dish antennas in California, Spain and Australia, as well as a Soviet radio telescope in the Crimea will be used. The landings, and the special DSN tracking, are expected to begin in April 1989.

Scientists are interested in the orbit of Phobos because it appears to be decaying. They believe tidal forces, the unequal attraction of gravity between different parts of two bodies, are making the moon spiral very slowly toward Mars and eventual destruction. Optical tracking is barely accurate enough to detect this phenomenon. Only active radio tracking, with a spacecraft on the site, can measure the orbit's decay rate.

The Deep Space Network, developed and operated by NASA's Jet Propulsion Laboratory over the past three decades, has built up unique expertise in determining the distance, within yards, and the velocity of spacecraft billions of miles from Earth.

(Editors note: At press time, Phobos 1 was experiencing communication difficulties.)

15,000 Schools Respond to Shuttle Orbiter-Naming Competition

The National Aeronautics and Space Administration announced that 15,000 schools across the nation have responded to its invitation to participate in the national competition to name the new Space Shuttle orbiter.

The new orbiter, currently designated OV 105, is being built to replace the Challenger and is scheduled to be completed in 1991.

To enter, U.S. students in kindergarten through 12th grade will form teams and research a name for the orbiter. The teams will prepare an interdisciplinary classroom project to support and justify the name selected. The name proposed must be of a sea vessel used in research or exploration.

Orbiter-naming projects must be completed during the fall semester and entries must be postmarked by Dec. 31, 1988.

Interested faculty members can obtain Orbiter-Naming Program Entry packets by contacting the Council of Chief State School Officers, which is administering the program for NASA, on (202) 783-5109 or (202) 783-5113.

Mark III Supercomputer Begins Operation at JPL

NASA's Jet Propulsion Laboratory (JPL), Pasedena, Calif., has announced the inauguration of its Mark III Hypercube parallel supercomputer, the result of a five year research and development effort at the JPL Center for Space Microelectronics Technology and the California Institute of Technology (Caltech).

Parallel computers are a solution to a fundamental limit on the speed of single computers. Because of the finite speed of light, a single processor is limited as to its ultimate speed.

To achieve a major speedup in problem solving, many single processors must be coordinated to work simultaneously on a single large problem, just as groups of workers subdivide the work and coordinate their efforts to complete a task too large for a single worker.

The Mark III represents the arrival of massively parallel supercomputing. Its first module, placed on-line on the Caltech computer network July 1, contains 32 nodes, or processing units, which together have a peak speed of about 512 million floating point operations per second. ■

HUMAN FACTORS

O'Brien Retires, Frankle Appointed NASA General Counsel

Edward A. Frankle has been named as general counsel of the National Aeronautics and Space Administration.

Frankle has been deputy general counsel since Oct. 27, 1985. He succeeds John E. O'Brien who has retired from NASA to enter private practice.

As NASA general counsel, Frankle will be chief legal officer responsible for the legal aspects of procurement, labor relations, personnel practices, freedom of information, real estate, contracts and other activities. He will direct a staff of attorneys at NASA Headquarters, Washington, D.C., and provide guidance to the legal staffs of NASA's field centers and service installations.

Frankle began his career with NASA in September 1982, as chief counsel of the Goddard Space Flight Center, Greenbelt, Md.

Before joining NASA, he was the associate director for policy development and administrative legal systems of the Selective Service System.

From 1974 to 1980, Frankle was a member of the Office of the General Counsel, Department of the Navy. ■

Tesch Appointed NASA Deputy General Counsel

Gary L. Tesch has been appointed NASA deputy general counsel.

Tesch joined NASA in 1968 as a procurement law specialist in the Office of General Counsel at NASA Headquarters. Between 1980 and 1982, he served as the chief counsel of NASA's Goddard Space Flight Center, Greenbelt, Md. In 1982, he returned to NASA Headquarters as associate general counsel (contracts) and has served in that capacity until the present appointment.

Before joining NASA, Tesch was a procurement law specialist with the Defense Supply Agency and, prior to that, served as a special agent for the Federal Bureau of Investigation.

Tesch holds membership in the State Bar of California and the Federal Bar Association and is the recipient of NASA's Exceptional Service Medal and other awards. ■

Diaz Leaves NASA

NASA Assistant Associate Administrator (Space Station) for the Office of Space Science and Applications, Al V. Diaz, has left NASA after a 24 year career. Diaz, who began his career as a co-op student at Langley Research Center has joined General Electric Company, G.E. Government Services, as Division Vice President of Space and Aeronautics Services.

Diaz holds a B.S. degree in physics and an M.S. degree in Management, achieved at the Massachusetts Institute of Technology through the Alfred P. Sloan Fellowship Program.

One of Diaz' proudest achievements was receiving the "Medal for Exceptional Scientific Achievement" for work as lead engineer on the Viking Gas Chromatograph—Mass Spectrometer which sampled the Mars surface and atmosphere.

Diaz will perform his General Electric responsibilities in Washington, D.C. ■

Weaver Retires from NASA Headquarters

Arell (Al) E. Weaver, Deputy Assistant Associate Administrator for Information Resources Management (IRM), has retired after over 25 years with NASA. As the acting head of NASA's IRM Office for the past two and one-half years, Weaver was responsible for developing and implementing NASA policy for the planning, acquisition, and utilization of automated information systems throughout NASA; for the development and implementation of agencywide administrative ADP systems; and for the operation of NASA's scientific and technical information facility.

Weaver contributed significantly through his leadership and representation of the NASA IRM community. He was an originator and strong supporter of the successful Automated Information Management (AIM) Program for agency-wide administrative ADP systems.

Prior to April 1986, he served in a number of management positions at NASA Headquarters in the Office of Management and the Office Manned Space Flight. Before joining NASA, Weaver was with the D.C. Board of Education and Vitro Electronics. ■

ANOTHER DIVIDEND FROM AIR & SPACE

Shuttle Technology Helps Oil Industry

by Charles Weirauch, KSC

A NASA-developed leak detection system designed for use in outer space may wind up buried underground to help combat pollution. The system, developed for the Space Shuttle orbiter in cooperation with Opto-Electronics Ltd. of Canada, is being studied as a means to detect groundwater contamination caused by oil well operations.

"We originally developed this system to quickly detect any leaks that might occur in the orbiter hydraulic systems," says Michael Padgett, an engineer in the processing section of KSC's Electronics Engineering Directorate. Padgett, and Bob Howard of the same directorate, worked with Opto-Electronics personnel to develop a prototype. "A fiberoptic sensor system is ideal for this use, since it is lightweight, compact and does not require electrical power in areas that may contain combustible or explosive gases," Padgett explained.

Such characteristics provide a direct application to pollution control, Padgett points out. The Environmental Protection Agency hopes to use a system similar to the one developed by NASA and Opto-Electronics to monitor Superfund toxic waste sites, he says. This application has prompted another electro-optics company to express interest in acquiring production and marketing rights to the system.

A major oil company is also interested in the NASA sensor technology because this industry is required by the EPA to monitor contamination of groundwater near operating oil wells, says Padgett. Present water sampling techniques are time-consuming and can cause sample contamination problems because of the handling involved, according to an EPA report.

"Our detection system eliminates such problems because it can detect contaminants right in the ground," Padgett stresses. "It's possible to bury an optical fiber and to attach 50 to 100 sensors to it. These sensors can be designed to be sensitive to certain kinds of soluble chemicals in the groundwater."

The leak detection system works by sending a laser pulse along the fiber-optic cable. Normally, a devise called an air-gap sensor causes the light beam to reflect back along the cable. When the sensor is wetted by a fluid that fills the gap, this fluid eliminates the reflection. The absence of a reflection indicates a leak, explains Padgett.

NASA Marks Thirtieth Anniversary
From page 3

Solar System, with only the planet Pluto as yet unexplored by deep space probes. Thirty years of life science studies have provided an understanding of the physiological effects of space flight, though much remains to be understood about the causes. In astronomy, the agency has looked at the Universe in all known wave lengths and is beginning to examine that information in detail.

Our earth-bound capability to observe the universe is limited by the turbulence and brightness of the atmosphere. The Hubble Space Telescope, expected to be placed

in orbit above the atmosphere in 1990, will distinguish fine details in planetary atmospheres or nearby star fields— with 10 times the clarity of the best ground observatories.

President Reagan made the development of a permanently manned U.S. space station a national goal in 1984. The President invited friends and allies of the United States to participate in the program and called for commercial private sector involvement. The space station has been named Freedom. Freedom will provide an unsurpassed research facility for scientific, technological and commercial activities in space and will serve as a base for continued exploration of the solar system in the next century. ■